The Kano Method's Imperfections, and Implications in Product Decision Theory

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Abstract: This paper assesses commonly used components of the Kano method, the Kano classification system and the self-report classification approach. Large differences in classifications between them are revealed thus establishing the need for a new classification system. Kano's original intent is clarified and a modification to Kano's original categories is suggested. A new method for attribute classification is proposed based on the estimation of satisfaction and usefulness as variables dependent on three levels of specification for the attributes (independent variables) in the product.

Keywords: Kano, Satisfaction, Delight, Must-be, Self-report, Metric Conjoint Analysis, Product Design

1. INTRODUCTION

In the article "Attractive Quality and Must Be Quality," Noriaki Kano *et al.* present a method to help designers focus their efforts on developing product attributes that are both functionally and emotionally satisfying to customers. This method, referred to as the Kano Method, separates into two parts[1]. The first part, which we term the *Kano categories*, recommends that designers focus their efforts by classifying product attributes into categories such as Must-be and Delighting. Kano's categories have been implemented in both engineering design and marketing research, with particular attention paid to the role Delighting product attributes may play in the success of products. The second part of the Kano Method, which we term the *Kano classification system*, uses a survey to classify attributes into the Kano categories by interpreting individuals' responses to simple questions about their feelings for the presence and absence of product attributes. This classification system, although sometimes seen in engineering and quality management publications, has not gained a wide acceptance in other academic communities, perhaps because of speculated weaknesses in the system due to problems with context effects and inaccuracy of predicted classifications. Therefore, some researchers have substituted a self-report approach to obtain the classifications, in which respondents directly classify attributes into the Kano categories, bypassing the Kano classification system[2-4]. This research investigates shortcomings of the Kano classification system and the self-report approach with a survey that tests two hypothesis:

Test I: Multiple choice answer framework matters when answering Kano questions.

Test II: Once undesirable data are eliminated from self-report classifications, the Kano classification system performs poorly in identifying the classification of attributes as individuals would classify the attributes themselves.

After presenting results and analysis from these hypothesis, we revisit the relationship between functionality and satisfaction as originally posed by Kano, and then proceed with a description of new classification methodology based on a clarification of this relationship.

2. KANO METHOD OVERVIEW

The Kano Method builds from the premise that a combination of the level of functional fulfillment and emotional satisfaction that a customer receives from a product relates to the customer's assessment of the product's quality. He proposed that the required levels, both functional and emotional, varied across a product's attributes, and that designers should target the proper combinations of functional fulfillment and emotional satisfaction when designing product attributes. The levels of functional fulfillment and emotional satisfaction targeted in an attribute are dictated by the categorization of the attribute into what Kano termed "quality elements," and what we term the Kano categories (Table 1). Table 1 includes a description of the attribute in the eyes of the product's user and a description of the actions that the designer should take in order to create adequate quality for each category of attribute. The Kano categories were originally visualized by Kano as a graph (Figure 1), which depicts the relationship between product attributes and an individual's emotional satisfaction and functional needs fulfillment.

Table 1 Description of the Kano categories and corresponding actions for product designers

Category (Alternate Names)	Description to User	Actions for Designer
Delighting (Attractive, Exciting, Value-Added)	If a product feature is "Delighting," it means that the feature provides extra product satisfaction for you when it is present, but the product still does its job perfectly well when the feature is absent.	Work to include attribute at a basic functioning level, as the mere presence of the feature will induce satisfaction.
One-dimensional (Performance, Proportional)	If a product feature is "One-dimensional," it means that the more attention we, the company, pay to this feature in the design of the product, the more satisfied you, the customer, are with the product and the better the product performs for you.	Work to increase the functionality of the attribute past industry standards.
Must-be (Basic, Expected)	If a product feature is "Must-be", it means the lack of this feature would definitely cause you dissatisfaction, and probably make the product not as useful to you. However, unlike a One-dimensional feature, extra design effort spent on improving a Must-be product feature would not make much difference to you – it just needs to be included and functioning normally.	Make sure the feature is included and functioning properly at an industry-standard level.
Indifferent	If a product feature is "Indifferent", it means that the feature does not provide either satisfaction or dissatisfaction to you.	Do not focus any attention here. Note that some attributes are Delighting to some customers while others feel indifferent or even reverse about these attributes.
Reverse	If a product feature is "Reverse," it means that the attribute causes you annoyance/ dissatisfaction and possibly makes the product less useful to you.	Make sure not to include these attributes.

2.1 Kano Classification System

In order to classify attributes into the Kano categories, the attributes are first classified at the individual customer level using a survey methodology and then aggregated. Respondents answer multiple choice questions about product attributes. For each attribute under consideration, respondents are first asked how they would feel the product includes the attribute (referred to as the functional question) and then how they would feel if the product did not include the attribute (referred to as the dysfunctional question). Below is an example set of questions from this paper's study of

an electric rechargeable toothbrush. Attributes are classified based on responses to the functional and dysfunctional questions (Table 2). Alternatively, researchers have asked survey respondents to classify the attributes directly into the Kano categories, based on brief explanations of the categories.

Functional Question:
If the toothbrush's bristles can vibrate at a variety of speeds, how would you feel?
If no responses apply or the question is confusing, leave the answer blank.

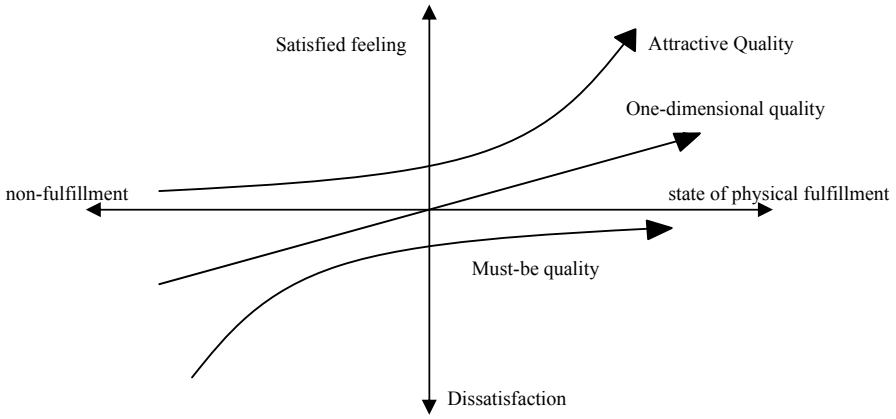
Responses: 1) I like it that way
2) It must be that way
3) I am neutral
4) I can live with it that way
5) I dislike it that way

Dysfunctional Question:
If the toothbrush's bristles always vibrate at the same speed, how would you feel?
(same responses)

Table 2 Kano classification table for responses to functional and dysfunctional questions[1]

		Response to Dysfunctional Question				
		I like it that way	**It must be that way**	**I am neutral**	**I can live with it that way**	**I dislike it that way**
Response to Functional Question	**I like it that way**	Questionable	Delighting	Delighting	Delighting	One-dimensional
	It must be that way	Reverse	Indifferent	Indifferent	Indifferent	Must-be
	I am neutral	Reverse	Indifferent	Indifferent	Indifferent	Must-be
	I can live with it that way	Reverse	Indifferent	Indifferent	Indifferent	Must-be
	I dislike it that way	Reverse	Reverse	Reverse	Reverse	Questionable

Figure 1 Relationship between attribute, emotional satisfaction and functional fulfillment



3. RESEARCH METHODOLOGY

Eighty University of Michigan graduate and undergraduate students were given a survey that investigated the hypotheses presented in the introduction. The survey was administered by computer in a four-part framework (Table 3) with an administrator present to answer questions. It took about 25 minutes to complete, and students were given a movie ticket for participating. The product under consideration in the survey was a rechargeable electric toothbrush, and the survey investigated six potential product attributes: variety of vibration speeds, brush head replacement indicator, recyclable brush heads, low battery indicator, automatic overcharge protection, and drip catch. The survey

also asked about price in the same manner as the product attributes.

Table 3 Overview of Survey Instrument

Part	Topic	Related Test	Response Format	Number of Conditions
Part One	Kano functional/dysfunctional question pairs	Test I	Multiple Choice or Scale	4
Part Two	Self-report classification of attributes into Kano categories and explanation for classification	Test II	Multiple Choice with write-in explanation	1
Part Three	Willingness to pay to add specific attributes to basic toothbrush		Write-in numeric	1
Part Four	Willingness to consider purchasing no-Must-be and no-delighters toothbrush	Test II	Multiple Choice with write-in numeric response or write-in explanation	1

In Part One of the survey, the subjects answered the seven pairs of questions containing a Kano functional and dysfunctional question exactly as described previously in the Kano Method Overview. There is one pair of questions for each of the seven attributes investigated (price, vibration speed, brush head replacement signal, recyclable brush heads, signal for low-battery, automatic overcharge protection, drip catch). Four equal groups (N=20) of respondents each used a different answer framework to answer the questions. The four answer frameworks are shown in Table 4 and Figure 2 below.

Table 4 Four different Kano answer frameworks investigated, three multiple choice and one scale

Answer Framework	**(1) Common Kano (set order)**	**(2) Randomized**	**(3) Simple Scale**	**(4) Rephrased Randomized**
Response A	1. I like it that way	I like it that way	Like	I would be delighted to find it that way
Response B	2. It must be that way	It must be that way	-	I expect it to be that way
Response C	3. I am neutral	I am neutral	-	I am neutral
Response D	4. I can live with it that way	I can live with it that way	-	I do not like it but I can live with it
Response E	5. I dislike it that way	I dislike it that way	Dislike	It must not be that way
Response F	Leave the answer blank	Leave the answer blank	Leave Blank	Leave the answer blank

Figure 2 Simple scale answer framework

In Part Two, the survey explained and defined the Kano categories of Must-be, One-dimensional, Delighting, and Indifferent and provided examples of attributes that would fall into these classifications (refer to Table 1 for exact wording). The survey then asked respondents to classify the seven product attributes into the Kano categories and explain their classification.

> How would you classify the product feature "Variety of Bristle Speeds?"
>
> - o Delighting
> - o One-dimensional
> - o Must-be
> - o Indifferent
> - o None of the above
>
> Click here to see the description of Delighting, One-dimensional, Must-be, Indifferent, and None of the above once again.
>
> Please briefly explain your classification: (Write-in Response)

In Part Three, respondents saw a description of a basic rechargeable toothbrush and were asked how much they would be willing to pay to add attributes individually to the basic design. Part Three is not analyzed in this paper, and therefore will not be discussed further. While the respondents took a brief five minute break from the survey, the survey administrator analyzed the respondents' answers to Parts One and Two and constructed the questions for Part Four. When the respondents returned to the survey, they were presented with the description of the basic rechargeable toothbrush again. Throughout the remainder of the survey, they could access the description at any time by clicking open a pop-up window:

> Basic electric toothbrush:
>
> - Price: $40.00
> - One bristle vibration speed
> - No indication when brush head needs to be replaced
> - Disposable (throw-away) brush head, non-recyclable
> - Toothbrush simply stops vibrating when it needs to be recharged
> - Must manually stop charging toothbrush to prolong battery life
> - No drip catch that prevents drips from the head of the brush from reaching your hand
>
> To review this basic toothbrush description at any point during the rest of the survey, just click the pop-up window on the following pages:
>
> "Click here for the price and description of a basic electric toothbrush"

In Part Four, the respondent was presented with up to four questions about hypothetical electric toothbrushes described in terms of the attributes mentioned in Parts One and Two, with the exception of price. Two of the four questions presented in Part Four relate to Test II reported below. The respondent was presented a toothbrush that included the functional state of all attributes *except* those the respondent classified as Must-be in Part Two (to be referred to as the "no-Must-be" toothbrush). Looking at the example question below, this respondent classified "drip catch" and "overcharge protection" as Must-be features. The survey asks respondents two questions: would they consider buying the no-Must-be toothbrush and, if they would, to specify the price they would pay. If they would not buy the product, the survey asks them to explain why.

The remaining section of Part Four asked respondents the same two questions about another toothbrush design that includes all of the attributes *except* those that the respondent indicated would be Delighting to them (the "no-Delighters" toothbrush).

> You are shopping for a new electric toothbrush. The following toothbrushes are available for purchase, amongst other alternatives. For each toothbrush shown, please tell us if you would consider purchasing the toothbrush or not. If you wouldn't consider purchasing it, please tell us why.
>
> Consider the following toothbrush:
>
> - Variety of bristle vibration speeds
> - Indicates when brush head needs to be replaced
> - Recyclable brush head
> - Low-battery indicator
> - Must manually stop charging toothbrush to prolong battery life
> - No drip catch that prevents drips from the head of the brush from reaching your hand
>
> (Will select one of the following)
>
> - **I would purchase this toothbrush for: $ (Numeric response)**
> - **I would not consider purchasing this toothbrush because: (Write-in response)**

4. RESULTS

Test I analyzes the responses to Part One of the survey in order to confirm that multiple choice answer framework matters when answering Kano questions. We found that survey scale does make a difference in how respondents answer the survey, as total count of multiple choice response option per respondent varies significantly across the four versions of multiple choice answer frameworks presented in Part One of the survey. Kano's originally proposed multiple choice scale appears to be interpreted almost identically to a simple Like to Dislike scale when answering functional questions. However, this interpretation does not hold when answering dysfunctional questions, where the two scales are significantly different in a One-way ANOVA ($p < 0.05$). Also, the positioning of "I am neutral" within the multiple choice response options plays a role in how often it is selected. Average response counts for answer options C in the functional question and B and D in the dysfunctional question were different in a one-way ANOVA ($p < 0.01$), as shown in Table 5. The finding that the Kano classification system is prone to survey methodology problems is consistent with the work of Sudman, Bradburn, Schwarz and others[5].

Table 5 ANOVA of Response Counts per respondent

Average Counts of:	**Functional Question Responses**					**Dysfunctional Question Responses**				
Answer Framework	(1)	(2)	(3)	(4)	Significance	(1)	(2)	(3)	(4)	Significance
Response A	4.40	4.30	4.40	4.50	0.980	0.15	0.05	0.20	0.00	.233
Response B	1.80	1.05	1.80	1.25	0.150	0.10	0.00	0.70	1.00	.000
Response C	0.55	1.25	0.55	1.20	0.007	1.20	2.05	2.25	1.80	.575
Response D	0.15	0.30	0.10	0.05	0.276	2.95	2.40	2.10	2.70	.005
Response E	0.05	0.05	0.10	0.00	0.722	2.55	2.45	1.75	1.50	.199
Response F	0.05	0.05	0.05	0.00	0.801	0.05	0.05	0.00	0.00	.061

Test II investigates the ability of the Kano classification system to categorize attributes as respondents would categorize the attributes themselves. Respondents are not adept at self-report classification, so analysis was performed to test the self-report responses for consistency across the survey[5, 6]. First, respondent's self-report classifications from Part Two of the survey were "cleaned." Independent judges eliminated self-report classifications from inclusion in Test II due to problems with the explanations provided for the classifications. The three problem categories identified were incorrect classifications (39 classifications removed), mentioning other attributes in the classification (51), and mentioning other customers in the classification (32). In the analysis of Part Four of the survey, the respondents were tested to see if they would behave in the manner they said they would, refusing to purchase toothbrushes that did not contain their Must-be attributes (33 classifications removed), and accepting purchase of toothbrushes that did not contain their Delighting attributes (3). In all, 140 out of 533 self-report classifications were removed from further analysis due to inconsistencies in self-report, substantiating the assertion that self-report is not an efficient way to determine Kano categories.

Kano method classifications (Chart A, Figure 3) are compared to the "cleaned" self-report classifications (Chart B, Figure 3) in Figure 3 below. In the charts in Figure 3, there is one row for each possible functional/dysfunctional question response. The Kano classification system had a poor fit to all four answer frameworks and therefore the figure has been condensed to save space, with more detail forthcoming in future publications. By comparing the grey shaded regions in Charts A and B, it can be concluded that the Kano method does not classify attributes as individuals would classify them in direct categorization.

To show the shortcomings of Kano's method more specifically, we will focus on the *dealbreaker* Must-be

classifications labeled "MB D" in Chart C, Figure 3 below. Out of all investigations into self-report accuracy, the investigation of dealbreaker Must-be attribute classifications is the most precise check on classification because respondents specifically state in Part Four of the survey that they will not purchase a described toothbrush scenario for *any* price because it does not include the dealbreaker Must-be attribute. Of the 37 dealbreaker Must-be attributes identified, Kano's method identified only 20 of these attributes as Must-be (across the four different answer frameworks). The cells containing the dealbreaker Must-bes not identified by the Kano method are shaded black with white text in Chart C. Kano's method identified only 6 out of 8 dealbreaker Must-bes for the group of the sample population that used Kano's original answer framework. This is serves to demonstrate that classifying using Kano's classification system means missing anywhere from 25% - 50% of the dealbreaker Must-be attributes classifications.

Figure 3 "Cleaned" self-report classification results compared to Kano classification method results

Answers to questions pairs shown along top (functional dysfunctional). D = Delighting, I = Indifferent, M = Must be, M D = Must-be dealbreaker, M ND = Must-be non-dealbreaker, O = One-dimensional.
Note: None of the Above vs. Reverse is not considered.

Chart A Kano Classifications

	11	12	13	14	15	21	22	23	24	25	31	32	33	34	35	41	42	43	44	45	51	52	53	54	55	Total
D		17	53	108																						178
I							3	19	29			9	35	9			2	3	2							111
M										51					3					3						57
O					70																					70
Total		17	53	108	70		3	19	29	51		9	35	9	3		2	3	2	3						416

Chart B Self-report Classifications

	11	12	13	14	15	21	22	23	24	25	31	32	33	34	35	41	42	43	44	45	51	52	53	54	55	Total
D	1	10	35	70	31			13	13	9	1	2	5	4				1	1	1			1			198
I	1	4	11	16	1	1	3	5	2			6	29	5				1	1	2	1					89
M		3	3	17	29				10	38					2		1	1							2	106
O			4	5	9			1	4	4		1			1											29
Total	2	17	53	108	70	1	3	19	29	51	1	9	34	9	3		1	3	2	3	1		1		2	422

Chart C Self-report Classifications with more detail for Must-be Classifications

	11	12	13	14	15	21	22	23	24	25	31	32	33	34	35	41	42	43	44	45	51	52	53	54	55	Total
D	1	10	35	70	31			13	13	9	1	2	5	4				1	1	1			1			198
I	1	4	11	16	1	1	3	5	2			6	29	5				1	1	2	1					89
M D				4	12				1	20																37
M ND		3	3	13	17				9	18					2		1	1							2	69
O			4	5	9			1	4	4		1			1											29
Total	2	17	53	108	70	1	3	19	29	51	1	9	34	9	3		1	3	2	3	1		1		2	422

5. A CLARIFIED PERSPECTIVE ON SATISFACTION AND FUNCTIONALITY

Although Kano's original method does not accurately classify features, the principles behind the method continue to have merit: classifying product attributes into the categories posed by Kano is a useful product design technique with rigorous applications[7]. Asking survey respondents simple satisfaction-oriented questions in order to ascertain classification into Kano categories is preferable to a self-report approach to categorization. In order to formulate a new model and method for classifying attributes, we will reexamine the basic premises behind the Kano method.

In basic terms, a user has four considerations about product attributes when evaluating a product for selecting or purchasing, whether conscious or sub-conscious:

1) Is the attribute useful or not?
2) If useful, is there one particular specification that would make the attribute more useful than another specification?
3) Does the attribute add to user emotional satisfaction or not?
4) If emotionally satisfying, is there one particular specification that would make the attribute more satisfying than another specification?

This perspective serves to clarify Kano's original theory, which saw satisfaction as a function of functionality (Figure 1), but leaves much more flexibility in the relationship between the two. Also, it clarifies that this function may be a step function for some attributes, depending on the user's opinions on considerations (1) and (2) above. Figure 4 is a collection of box charts that clarify the relationship between the Kano categories and the users' opinions by attribute. Note that only steps (2) and (4) involve the specification level, what Kano may have originally perceived as functionality. We therefore use the term *functionality* when referring to the level of development of the attribute's specifications. We introduce a new term, *usefulness*, as the perception of functionality by the user. In some categories, different levels of functionality have the same level of usefulness to the customer, just as different levels of functionality may give the same level of satisfaction to the user. When improved specification of the attribute does not correlate to improved usefulness or satisfaction, but affects them in a yes/no manner, the boxes are shown as black. When level of specification does control usefulness or satisfaction, the boxes have a shaded gradient. Ting et al. developed a related representation using curves that relate satisfaction to product characteristics rather than box charts[8].

Figure 4 Box charts clarify the relationship between user considerations and the Kano categories

A specification-dependent relationship is shown as a shaded gradient.

Must-be

Usefulness	Useful	Not Useful
Presence		
Absence		

Feeling	Satisfied	Dissatisfied
Presence		
Absence		

Delighting

Usefulness	Useful	Not Useful
Presence		
Absence		

Feeling	Satisfied	Dissatisfied
Presence		
Absence		

One-Dimensional

Usefulness	Useful	Not Useful
Presence		
Absence		

Feeling	Satisfied	Dissatisfied
Presence		
Absence		

Indifferent

Usefulness	Useful	Not Useful
Presence		
Absence		

Feeling	Satisfied	Dissatisfied
Presence		
Absence		

Impulse

Usefulness	Useful	Not Useful
Presence		
Absence		

Feeling	Satisfied	Dissatisfied
Presence		
Absence		

Unwanted (based on Reverse)

Usefulness	Useful	Not Useful
Presence		
Absence		

Feeling	Satisfied	Dissatisfied
Presence		
Absence		

These charts separate Kano's original category of Delighting into two sub-categories: *Impulse* and Delighting. In the Delighting category, users receive extra usefulness and satisfaction based on the specification of the attribute. In the Impulse category, any specification produces the same level of usefulness and the same level of satisfaction. The category of Unwanted captures the spirit of Kano's Reverse category with more precision. The charts in Figure 4 emphasize that there are only two situations in which satisfaction and functionality are linked by a function more complicated than a step function: One-dimensional and Delighting.

Although the charts serve to clarify the Kano categories, they are over-simplifications of the user's product considerations. Often, the usefulness of one attribute is dependent on the presence and specification of another attribute, creating correlations between the two attributes in usefulness and satisfaction. Furthermore users have trouble assessing their feelings of both usefulness and satisfaction for the specification of one attribute without knowing the specification of other attributes. The Kano method as it currently stands cannot address either of these issues. It is also desirable to have a mathematically elegant way to classify attributes at either an individual or group level, and have both types of classifications include error terms to indicate the statistical significance of the classification. A new method is required to address these issues.

Elrod et al. fit the results of a discrete choice analysis to flexible functions representing the utility of attributes over varying specifications that can be shaped like any of the graphs originally proposed by Kano[6]. However, Elrod et al. model utility, which can be viewed as a combination of usefulness and satisfaction, but do not attempt to model these two qualities individually. Furthermore, a discrete choice framework is poor at identifying Impulse and Must-be features. If utility is viewed as a combination of satisfaction and usefulness, then an Impulse (or Must-be) feature would have a utility value based on the presence or absence of the feature, not on specification past industry standard. However, in discrete choice surveys and in order to obtain the data necessary to model the GNH function used by Elrod et al., the product choices available must be shown with different attribute specifications compared across choice options. This comparison has been shown to induce demand artifacts for different levels of attribute specifications, where individuals will prefer one level of an attribute over another even if they are specifically told there is no difference between these two attribute levels[9].

6. A NEW CATEGORIZATION METHODOLOGY

This new categorization methodology is based on the fact that the box charts for both satisfaction and usefulness in Figure 4 are unique to each classification. Therefore, if one can create the box chart for either satisfaction or usefulness, one can classify the attribute. The new methodology begins with a survey that presents product scenarios and asks two Likert-scale ranking questions[5]:

> You are shopping for a new electric toothbrush. Consider the following toothbrush:
>
> - Variety of bristle vibration speeds
> - Indicates when brush head needs to be replaced
> - Recyclable brush head
> - Low-battery indicator
> - Must manually stop charging toothbrush to prolong battery life
> - No drip catch that prevents drips from the head of the brush from reaching your hand
>
> How would using this product make you feel?
>
> ○ ○ ○ ○ ○ ○ ○
>
> Completely Completely

Unsatisfied Satisfied

How useful would this product be to you?

○ ○ ○ ○ ○ ○ ○

Not at all useful Very Useful

Within these questions, product attributes are presented in the scenario at one of three levels: 1 = Present A, 2 = Present B, and 3 = Absent. Present B is a more functional specification state for an attribute than Present A. Absent is much like the dysfunctional Kano question and should be stated in a neutral manner. An example of the three levels for the electric toothbrush attribute of "variety of bristle vibration speeds" is:

1) Bristles vibrate at two different speeds
2) Bristles vibrate at five different speeds
3) Bristles always vibrate at the same speed

It may be helpful to include a price in the product scenarios, not as an attribute but as a prime to help individuals focus on evaluating the attributes instead of wondering about price. All prices should be within a close and insignificant range of each other, and the toothbrushes with more features should have higher prices than those with less. Any attribute that does not have an Absent option available, such as miles per gallon of a car, can have level (3) set to a functionality considerably below industry standard.

The method requires an estimation of the effects (coefficients) of the attribute levels on the ratings. The results of the survey can be analyzed either as a simple linear regression or with a hierarchical linear model[10]. The dependent variables are satisfaction and usefulness, analyzed separately. The independent variables are the levels of the attributes. For this method, three coefficients are estimated for each attribute *j* as follows:

β_{3j} of $\beta_{3j} x_{3j}$	the effect of level 3 (Absence) of attribute *j*
$\beta_{(1+2)j}$ of $\beta_{(1+2)j} (x_{1j} + x_{2j})$	the combined effect of levels 1 and 2 (Present A, Present B) of attribute *j*
$\beta_{(2-1)j}$ of $\beta_{(2-1)j} (x_{2j} - x_{1j})$	the difference between the effects of level 1 and level 2 of attribute *j*

The method focuses on two qualities of the estimated coefficients (effects) for the attribute levels:

1) Sign (positive, negative, zero)
2) Significance ($p \leq p_{critical}$ = significant, $p \geq p_{critical}$ = not significant)

The coefficients can be estimated for the individual or group, and latent classes can also be determined. Covariances amongst coefficients can be identified and modeled with grouped attribute parameters to improve the fit of the model and identify attributes that should be included in (or excluded from) the product in tandem. The magnitude of the estimated coefficients is left for discussion in future publications, but will most likely correlate to the importance of the attribute in the product.

Attribute (j) can be classified into a category based on estimated satisfaction coefficients (Table 6):

Table 6 Classifications based on estimated coefficients for satisfaction

Satisfaction Coefficients	Must Be	One-dimensional	Impulse	Delighting	Indifferent	Unwanted	Unknown
β_{3j}	< 0, Sig.	< 0, Sig.	≈ 0 or Not Sig.	≈ 0 or Not Sig.	≈ 0 or Not Sig.	≥ 0 or Not Sig.	Any other combina -tion
$\beta_{(1+2)j}$	≈ 0 or Not Sig.	> 0, Sig.	> 0, Sig.	> 0, Sig.	≈ 0 or Not Sig.	< 0, Sig.	
$\beta_{(2-1)j}$	≈ 0 or Not Sig.	> 0, Sig.	≈ 0 or Not Sig.	> 0, Sig.	≈ 0 or Not Sig.	≤ 0 or Not Sig.	

The same procedure is followed for usefulness, with a different classification chart (Table 7):

Table 7 Classifications based on estimated coefficients for usefulness

Usefulness Coefficients	Must Be	One-dimensional	Impulse	Delighting	Indifferent	Unwanted	Unknown
β_{3j}	< 0, Sig.	< 0, Sig.	≈ 0 or Not Sig.	≈ 0 or Not Sig.	≈ 0 or Not Sig.	≥ 0 or Not Sig.	Any other combina -tion
$\beta_{(1+2)j}$	> 0, Sig.	> 0, Sig.	> 0, Sig.	> 0, Sig.	≈ 0 or Not Sig.	< 0, Sig.	
$\beta_{(2-1)j}$	≈ 0 or Not Sig.	> 0, Sig.	≈ 0 or Not Sig.	> 0, Sig.	≈ 0 or Not Sig.	≤ 0 or Not Sig.	

A limitation of the proposed categorization scheme is that it relies on statistical significance of parameters in a regression, which is influenced by sample size. An obvious alternative is to base the categorization on a measure of effect size rather then statistical significance. Alternative measures on which to base the categorization scheme will be explored in subsequent research.

It is possible to classify attributes into Kano categories based on rating product scenarios only on satisfaction or only on usefulness. However, it is expected that measuring both quantities will be necessary to achieve significant classifications for all attributes. For example, some attributes, such as variety of colors available in a car, are expected to increase the overall usefulness of a car by only a tiny amount when compared to an attribute such as miles per gallon. Therefore, a significant coefficient in the usefulness estimate may not be possible for the variety of colors attribute when miles per gallon is also present as an attribute. However, the term for variety of color is more readily estimated for satisfaction. If the results for any attribute conflict based on the two estimations, the classification will be determined based on the compared size of the coefficients, or the attribute will be classified as unknown.

7. CONCLUSIONS

This paper assessed the current state of commonly used Kano methods, identifying shortcomings of both the Kano classification system and the self-report classification approach. The paper revealed large differences in classifications between the self-report approach and the Kano classification system. As there are drawbacks to both methods, the authors suggested criteria for a new model that are not prone to the drawbacks of either current method:

- Classifies for one individual or a group
- Presents product scenarios to survey respondents for assessment rather than individual attributes
- Shows the degree of certainty in its predictions
- Is free of self-report errors
- Includes only easy-to-answer and understand questions

These criteria are inline with modern marketing survey techniques and survey design procedures. The intent of introducing these criteria is not only to offer an improved Kano model, but also to increase the acceptance of the model outside of the engineering community and prepare it for introduction to the marketing and psychology communities. The model may also find new applications outside the realm of product design such as negotiation, where it is especially difficult to ascertain decision strategies on sensitive topics.

In response to the above criteria, first we clarified Kano's original intent, linking both satisfaction and usefulness to the presence/absence of attributes in the product and the specifications (Functionality) of the attribute. We suggested changing Kano's original categories to Must-be, One-dimensional, Delighting, Impulse, Indifferent, and Unwanted. We then proposed a new method for attribute classification based on the estimation of satisfaction and usefulness as variables dependent on three levels of specification for the attributes in the product. In this new model, the sign and significance of the estimated coefficients for combinations of the independent variables (the attribute levels) predict the

overall classification of the attribute. The validity of this method will be tested in future work.

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